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SEISMIC SAFETY ELEMENT
OF THE CITY OF FULLERTON
GENERAL PLAN

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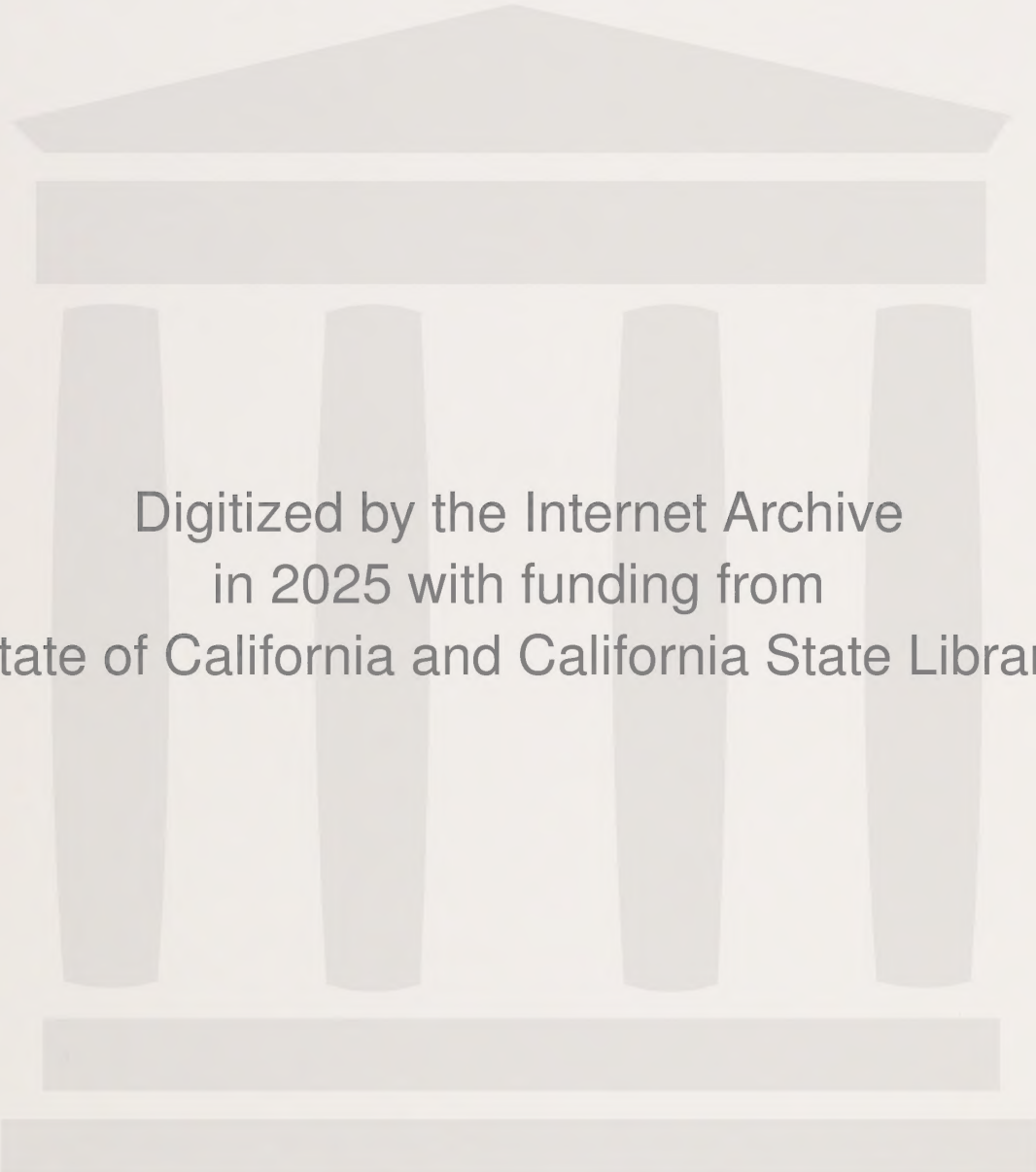
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Adopted October 15, 1974

SEISMIC SAFETY ELEMENT
OF THE CITY OF FULLERTON
GENERAL PLAN



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INTRODUCTION

This Seismic Safety Element was prepared from a report by W. A. Wahler and Associates, engineering geologists who did a seismic and geologic analysis of the City and, in more detail, the East and West Coyote Hills. The document identified as a Technical Appendix in this Element is their Seismic Safety Element Study - Phase II which includes a complete report on their methodology, findings, and conclusion. That report is incorporated by reference into this document and shall be held on file in the Development Services Department offices, to be available to the public.

This Element, as presented, includes a summary of findings, goals, objectives and policies, and plan implementation tools. It is designed to be a policy tool for the City and to be used as a technical (along with the Technical Appendix) report for review of new development and redevelopment programs and for use in Environmental Impact Reports.

SUMMARY OF FINDINGS

The City of Fullerton, like many other cities in Southern California, is subject to damage from earthquakes. As in most other cities, the greatest potential damage and potential for injury due to an earthquake lies with buildings that cannot withstand earthquake shaking. Planning future buildings that can survive earthquakes is relatively easy; correcting the hazards posed by older structures is relatively difficult.

No major faults cut through Fullerton, but two potentially active minor fault systems do lie within the City. These are the Norwalk fault and the Idaho Canyon fault. The Norwalk and Idaho Canyon faults, and some faults in the Coyote Hills similar to the Idaho Canyon fault, deserve some special considerations in land use planning. The Norwalk fault has not been located precisely at the ground surface; in fact, there is doubt as to whether it extends to the ground surface or is capable of producing surface rupture during an earthquake. Three zones are defined in the Technical Appendix and shown on Plate 1 each of which might contain the Norwalk or a related fault if the fault extends to or near the ground surface. The principal action to take with respect to the Norwalk fault is to adopt policies requiring that more knowledge be gained about it.

Although potentially active faults within the City deserve special precautions, of even greater economic impact is a likely moderate to great earthquake on any of several active local and regional faults. Fullerton is subject to the ground shaking effects from earthquakes on several faults. One of these, the "controlling earthquake", is a magnitude 8.25 event on the San Andreas fault. This earthquake equals or overshadows likely earthquakes on the San Jacinto, Newport-Inglewood, Sierra Madre, Santa Monica-Raymond Hill and, in most respects, even a likely moderate earthquake on the Whittier fault. As a guide to planning, studies were performed to determine if different parts of the city have different seismic response (ground shaking) characteristics or are subject to specific seismic hazards. Five seismic and fault hazard zones have been delineated:

- A - Possible location of Norwalk or related fault,
- B - Ground Shaking,
- C - Potential for nontectonic surface rupture along minor faults in the West Coyote Hills,
- D - Possible seismically induced bedrock landslides,
- E - Areas most likely to be subject to liquefaction, consolidation, and lurching effects.

The planning implications of these zones are presented in the Technical Appendix. Seismic Hazard Zone B, Ground Shaking, contains the entire city and all the other

Hazard Zones. Seismic Hazard Zone A contains about 6% of the total area of the city. Seismic Hazard Zone C contains about 1% of the city. Seismic Hazard Zone D contains about 3% of the City, and Seismic Hazard Zone E about 10% of the city. Thus, around 80% of the City of Fullerton is judged relatively free of all earthquake effects except ground shaking and attendant structural damage.

The principal concerns in the Coyote Hills, from the standpoint of secondary earthquake effects, are the possibilities of landslides and the potential for settlement (consolidation) of loose fills. Liquefaction may be possible in the extreme northern part of Fullerton and in the alluvium of stream valleys in the Coyote Hills. Consolidation and landslides are unlikely in the southern alluvial parts of the city, as is liquefaction. Here simple structural response to the ground shaking is the major concern.

Ground surface rupture is the only primary earthquake effect for which special zoning is feasible. Three possible locations of the Norwalk fault zone have been identified as bands averaging 500 feet in width. Several very minor faults in the West Coyote Hills are judged capable of ground surface rupture, but principally as a result of stress introduced by oil field operations rather than from earthquakes. These small faults are not deemed capable of causing damaging earthquakes, but they may undergo small secondary displacements when a large earthquake occurs.

A full analysis confirms that the principal damage from earthquakes is likely to be damage to older buildings (especially older multi-story or large buildings) rather than from ground rupture. The older buildings also constitute the likely major source of death and injury as a result of an earthquake. Ground shaking effects on buildings and other structures can cause widespread and extensive damage, whereas landslides, liquefaction, consolidation and surficial fault rupture are localized.

SEISMIC HAZARDS AND THEIR EFFECT ON THE COMMUNITY

Seismic hazards exist in many forms and degrees of severity. Seismic hazards include both natural phenomena and man-made things that are capable of causing a loss to individuals or a community when an earthquake occurs. The loss may be structural, physical (bodily injury or death) or financial. Thus, a steep slope that might be unstable when loaded by earthquake vibrations is a landslide hazard. An unreinforced parapet wall on a building might fall to the street and injure people; it is a type of structural hazard.

Fullerton is subject to strong earthquake shaking likely to occur in the foreseeable future. The historic record provides a clue to future probabilities. The Fullerton area has experienced Modified Mercalli Intensity VII (the onset of structural damage) six times in the 205 years of historic earthquake record in Southern California. (A description of the Modified Mercalli Intensity Scale and a comparison of it with the Richter Scale are found in Tables 1 and 2.)

It is widely held very probable that a major earthquake will occur in the San Andreas fault within 50 years. Other faults may have earthquakes also, of course, and in a sense this simply adds to the hazard posed by the San Andreas fault. Fifty years is chosen as a time interval of interest because it is within the lifetime of those presently living - or the lifetime of their children. From an economic standpoint, the life of a major structure is seldom taken as more than 100 years, so very rare seismic hazards (such as earthquakes with very long recurrence intervals) may be only of minor interest.

The effect of seismic hazards on the community will vary with three factors: intensity of the hazard, the density of the population, and the nature of the precautions taken. Effects of seismic hazards include life loss, injury, damage to structures and property, and economic loss. Economic loss stems not only from damaged facilities which must be repaired, but from disruption of normal activities and loss of wages during the recovery period. The cumulative effect can be great, and the recovery period may take several years.

NATURE OF ACCEPTABLE RISK

An acceptable risk is a risk of such level that no specific action by local government is necessary, other than making the risk known. An unacceptable risk is one of such level that specific action by local government is deemed necessary to protect life and property. Earthquake or seismic risk is the chance or probability that loss, death or injury will occur due to an earthquake. It is nearly certain that Fullerton will be subjected to a damaging earthquake within the next 50 years; that is, the risk level may be very high under certain circumstances. It is not possible, at the present state of the art, to reduce the probability that a given earthquake will occur. The only way to reduce the earthquake risk is indirectly, by reducing the risks from damage and life loss by implementing suitable precautions.

Acceptable risk level is not subject to a rigid, uniformly applicable definition. The level of risk acceptable, or level of safety required, varies depending on the nature of the project and even with subjective judgments about its associated hazards. The consequences of failure, regardless how remote, are generally considered. As a rough guide we can say that, for various classes of structures, society (or the community) can measure its acceptable risk level by relating it to an increase in cost over the normal cost of the structure. Nuclear reactors and large dams have very high consequences of failure, hence the level of safety required is very high, and large sums are spent achieving it. Both of these classes of structures as well as schools and hospitals are outside the jurisdiction of local communities as far as safety regulations are concerned.

For all other classes of structures, the Uniform Building Code (UBC) Prescribes requirements for seismic safety.

Engineers preparing the UBC changes are constantly updating seismic requirements to include latest results from studies and testing. It is important that the City adopt these changes as they are promulgated.

In comparison of acceptable risk, it was found that the risk of death due to an earthquake-caused injury is on the order of ten times less than the risk of death from disease in Fullerton. This degree of safety is basically acceptable to many people, but adherence to latest UBC requirements plus requiring special geologic tests in questionable areas can achieve a marked increase in earthquake safety.

GOALS AND POLICIES

The City of Fullerton has had good fortune in the past with geologic and seismic hazards: no lives have been lost. This fact tends to make people believe that the possibility of a geologic disaster is not present. But this is an unreasonable assumption. As geologic research continues, we are becoming aware that a disaster in Southern California which could include our city is not at all impossible.

The overall goal of the City is to limit insofar as possible, the loss of life, injuries, damage to property, and social-economic dislocations from seismic-geologic hazards. The existing policy of adopting all new editions of the UBC and the requirement within said Code for engineering geology and soil engineering reports prior to the issuance of building permits provides the primary means of implementing the goal. The following policies can increase the scope of protection provided to the residents of the City:

1. Make the contents of the W. A. Wahler and Associates study available to school districts, property owners, developers, and other interested parties.
2. Require recognition of said study for development in identified hazard management areas and proof, by the developer, that necessary measures have been taken to overcome said hazards.
3. As a part of any inspection of older buildings and as a part of any building code enforcement program, cause to be corrected any structural element deemed unsafe to life when identified as a seismic hazard.
4. Support realistic programs which increase knowledge in geologic and seismic matters in general and, more specifically, those which provide additional data on conditions in Fullerton.

RELATIONSHIP TO OTHER GENERAL PLAN ELEMENTS

All elements of the General Plan are, to some degree, related and interdependent. The Seismic Safety Element relates specifically to the Land Use, Circulation, Housing, Open Space, and Safety Elements. When considering any changes to said elements, or any programs in implementation of said elements, the implications of the geologic and seismic study and the goals and policies established herein provide guidance to insure that seismic and geologic considerations are coordinated throughout the plan.

EXPLANATION

GEOLOGIC UNITS

BEDROCK UNITS

Qal

ALLUVIUM

Qt

TERRACE DEPOSITS

SURFICIAL UNITS

Qlh

LA HABRA FORMATION

Qch

COTATE HILLS FORMATION

Qsp

SAN PEDRO FORMATION

NOTE: SEE TEXT FOR DETAILED EXPLANATION OF UNITS

SYMBOLS

FAULT: U-UPTHROW, D-DOWNTHROW, SIDE. DOTS ADDED WHERE BURIED, QUERIED WHERE EXTENSION UNCERTAIN. ARROWS SHOW RELATIVE DIRECTION OF HORIZONTAL MOVEMENT.

SEMI-RECENT OF TONGUE CANYON FAULT ON WHICH SURFICIAL DISPLACEMENT OCCURRED ON OR ABOUT OCTOBER 1, 1968 (SEE TEXT)

FAULTS RELATED TO TONGUE CANYON FAULT, SURFICIAL DISPLACEMENT MAY OCCUR (SEE TEXT)

PROBABLE LOCATIONS FOR NORRALK FAULT. LIKELY RANGE OF ERROR INDICATED BY WIDTH OF SCREEN PATTERN. PROBABILITY OF SURFICIAL DISPLACEMENT ALONG ANY ONE OF THE INDICATED ZONES CAN BE ESTIMATED ONLY AFTER DETAILED EXPLORATION. ONE OR MORE OF THE INDICATED PROBABLE ZONES MAY NOT EXIST (SEE TEXT)

MINOR FAULT, REVERSED TECTONIC MOVEMENT OR SURFICIAL DISPLACEMENT ARE CONSIDERED VERY UNLIKELY.

FORMATION CONTACT; DOTTED WHERE BURIED, QUERIED WHERE UNCERTAIN

ANTICLINAL FOLD AXIS

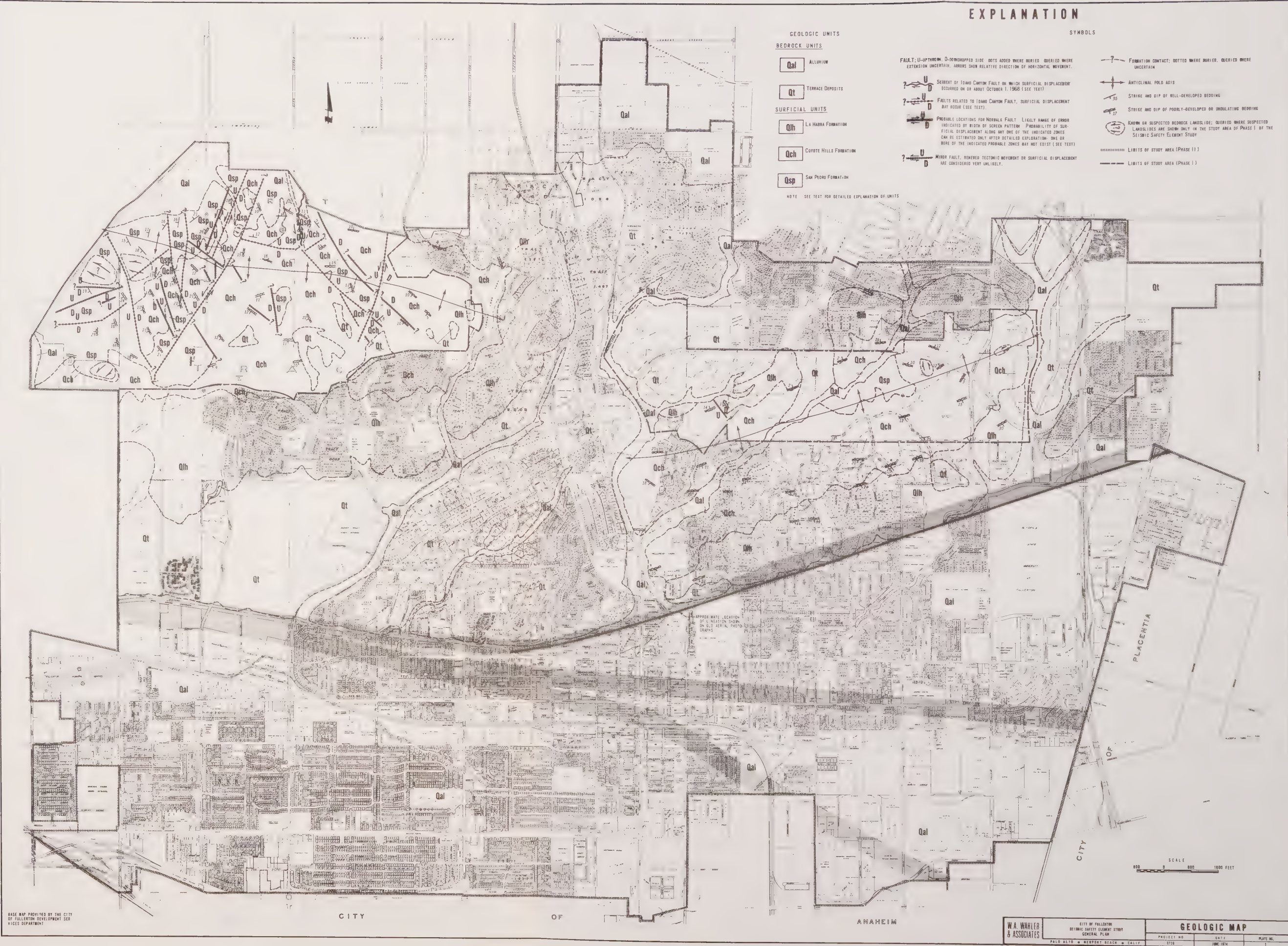
STRIKE AND DIP OF WELL-DEVELOPED BEDDING

STRIKE AND DIP OF POORLY-DEVELOPED OR UNOCCUPYING BEDDING

KNOWN OR SUSPECTED BEDROCK LANDSLIDES; QUERIED WHERE SUSPECTED LANDSLIDES ARE SHOWN ONLY IN THE STUDY AREA OF PHASE I OF THE SEISMIC SAFETY ELEMENT STUDY

LIMITS OF STUDY AREA (PHASE II)

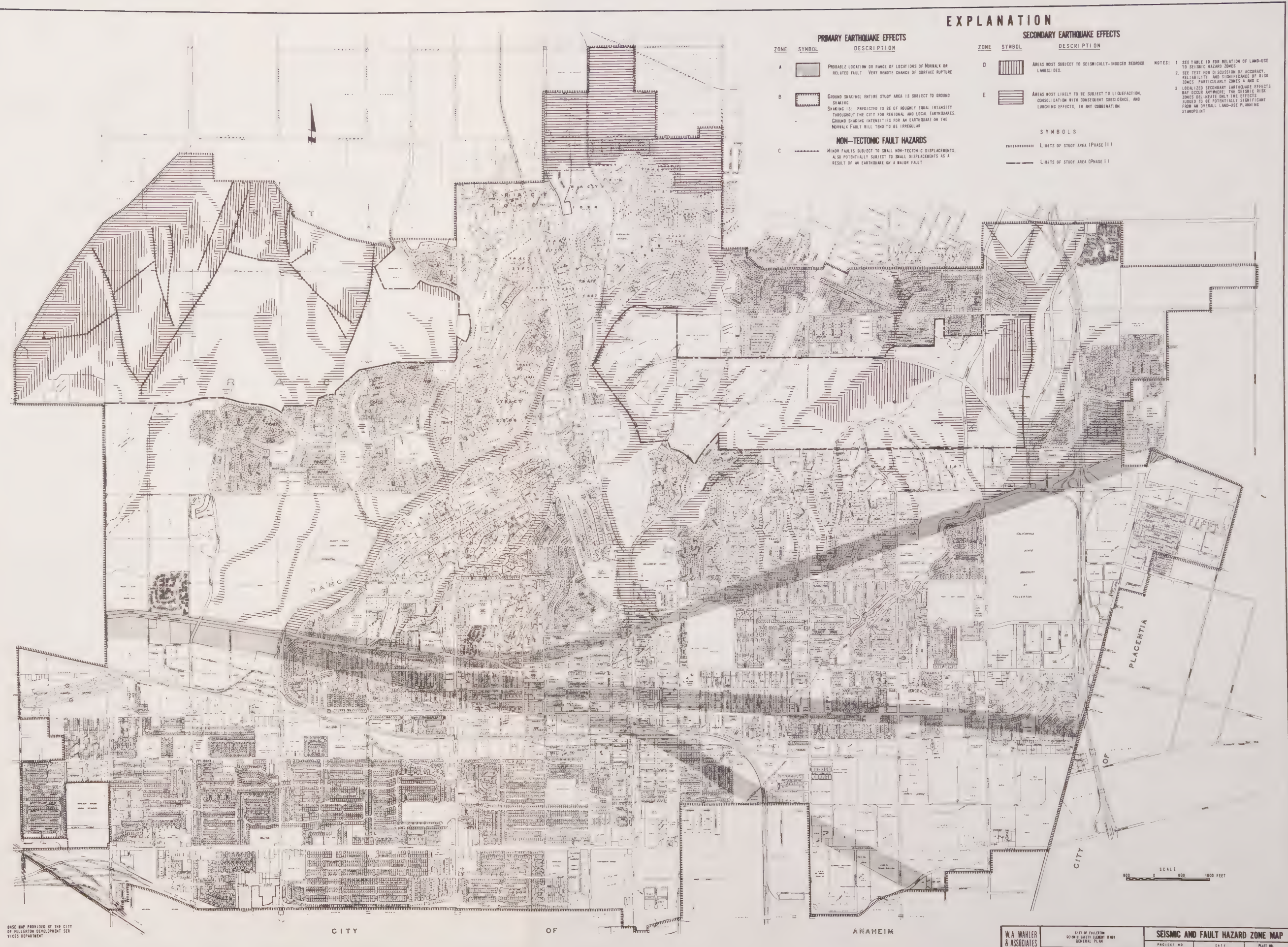
LIMITS OF STUDY AREA (PHASE I)



BASE MAP PROVIDED BY THE CITY OF FULLERTON DEVELOPMENT SERVICES DEPARTMENT

CITY OF FULLERTON

W.A. WAHLER & ASSOCIATES	CITY OF FULLERTON SEISMIC SAFETY ELEMENT STUDY GENERAL PLAN			GEOLOGIC MAP	
	PROJECT NO.	DATUM	PLATE NO.		
	0755	1974	1		



EXPLANATION

PRIMARY EARTHQUAKE EFFECTS		
ZONE	SYMBOL	DESCRIPTION
A		PROBABLE LOCATION OR RANGE OF LOCATIONS OF NORMAL OR RELATED FAULT. VERY REMOTE CHANCE OF SURFACE RUPTURE
B		GROUND SHAKING: ENTIRE STUDY AREA IS SUBJECT TO GROUND SHAKING. SHAKING IS: PREDICTED TO BE OF ABOUT EQUAL INTENSITY THROUGHOUT THE CITY FOR REGIONAL AND LOCAL EARTHQUAKES. GROUND SHAKING INTENSITIES FOR AN EARTHQUAKE ON THE NORMAL FAULT WILL TEND TO BE IRREGULAR
C		NON-TECTONIC FAULT HAZARDS MINOR FAULTS SUBJECT TO SMALL NON-TECTONIC DISPLACEMENTS, ALSO POTENTIALLY SUBJECT TO SMALL DISPLACEMENTS AS A RESULT OF AN EARTHQUAKE ON A MAJOR FAULT

SECONDARY EARTHQUAKE EFFECTS		
ZONE	SYMBOL	DESCRIPTION
D		AREAS MOST SUBJECT TO SEISMICALLY-INDUCED REDMUD LANDSLIDES
E		AREAS MOST LIKELY TO BE SUBJECT TO LIQUEFACTION, CONSOLIDATION WITH CONSEQUENT SUBSIDENCE, AND LUNGING EFFECTS, IN ANY COMBINATION
SYMBOLS		
		LIMITS OF STUDY AREA (PHASE II)
		LIMITS OF STUDY AREA (PHASE I)

NOTES: 1. SEE TABLE 10 FOR RELATION OF LAND-USE TO SEISMIC HAZARD ZONES
2. SEE TEXT FOR DISCUSSION OF ACCURACY, RELIABILITY, AND SIGNIFICANCE OF RISK ZONES, PARTICULARLY ZONES A AND C
3. LOCALIZED SECONDARY EARTHQUAKE EFFECTS MAY OCCUR ANYWHERE; THE SEISMIC RISK ZONES DELINEATE ONLY THE EFFECTS JUDGED TO BE POTENTIALLY SIGNIFICANT FROM AN OVERALL LAND-USE PLANNING STANDPOINT

BASE MAP PROVIDED BY THE CITY OF FULLERTON DEVELOPMENT SERVICES DEPARTMENT

CITY OF FULLERTON ANAHEIM

W.A. WAHLER & ASSOCIATES	CITY OF FULLERTON SEISMIC SAFETY ELEMENT TO CITY GENERAL PLAN	SEISMIC AND FAULT HAZARD ZONE MAP	
	PROJECT NO. 0736	DATE: JUNE 1974	PLATE NO. 2
	PALO ALTO • BERKELEY BEACH • CALIF.		

TABLE 1
MODIFIED MERCALLI INTENSITY SCALE
1956 VERSION

Because the performance of masonry is such an important criterion for evaluating intensity, this version specifies four qualities of masonry, brick or otherwise, as follows:

<u>Masonry A.</u>	Good workmanship, mortar, and design; reinforced, especially laterally, and bound together using steel, concrete, etc.; designed to resist lateral forces.
<u>Masonry B.</u>	Good workmanship and mortar; reinforced, but not designed in detail to resist lateral forces.
<u>Masonry C.</u>	Ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at corners, but neither reinforced nor designed against horizontal forces.
<u>Masonry D.</u>	Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

<u>INTENSITY</u>	<u>EFFECTS</u>
I	Not felt. Marginal and long-period effects of large effects of large earthquake.
II	Felt by persons at rest, on upper floors, or favorably placed.
III	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.
IV	Hanging objects swing. Vibration like passing of heavy trucks, or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frame creak.
V	Felt outdoors; direction estimated. Sleepers awakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

- VI Felt by all. Many frightened and run outdoors. People walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken visibly, or heard to rustle.
- VII Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices, unbraced parapets and architectural ornaments. Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
- VIII Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B, none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.
- IX General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. General damage to foundations. Frame structures, if not bolted, shifted off foundations. Frame cracked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluvial areas, sand and mud ejected, earthquake fountains, sand craters.
- X Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.
- XI Rails bent greatly. Underground pipelines completely out of service.
- XII Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

In the foregoing, each effect is named at that level of intensity at which it first appears frequently and characteristically. Each effect may be found less strongly, or in fewer instances, at the next lower grade of intensity; more strongly or more often at the next higher grade. A few effects are named at two successive levels to indicate a more gradual increase.

TABLE 2

COMPARISON OF MAGNITUDE AND INTENSITY

It is difficult to compare magnitude and intensity because intensity is linked with the particular ground and structural conditions of a given area, as well as distance from the earthquake epicenter, while magnitude is a measure of the energy released at the focus of the earthquake.

<u>Richter Magnitude</u>	<u>Expected Modified Mercalli Maximum Intensity (at epicenter)</u>	
2	I-II	Usually detected only by instruments
3	III	Felt indoors
4	IV-V	Felt by most people; slight damage
5	VI-VII	Felt by all; many frightened and run outdoors; damage minor to moderate
6	VII-VIII	Everybody runs outdoors; damage moderate to major
7	IX-X	Major damage
8+	X-XII	Total and major damages

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